

REMARKS

In light of this Amendment, Applicant respectfully submits that the application in condition for allowance.

With regard to the objections to the specification, applicant has amended the specification to employ consistent language in describing the features of the present invention.


With regard to the rejection of claims 1-21 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, applicant has amended appropriate claims to more precisely define the scope of those claims.

Further with regard to the rejections of claims 1-21, applicant has amended the claims, when necessary, to provide all features therein with proper antecedent basis.

In light of the foregoing, it is submitted that the application is in a condition for allowance and notice to that effect is hereby requested.

If there are any fees resulting from this communication, please charge same to our Deposit Account No. 16-0820, our Order No. 33441.

Respectfully submitted,
Pearne & Gordon, LLP

By: 
Donald J. Firca, Jr., Reg. No. 48140

526 Superior Ave. East, Suite 1200
Cleveland, OH 44114-1484
(216) 579-1700

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MARKED-UP COPY OF THE SPECIFICATION

IN THE SPECIFICATION

The specification was amended as follows:

The paragraph starting on page 12, line 8, was amended as follows:

A cavity 6 has the general shape of a rectangular parallelepiped of length l , width more or less $l/4$ and height somewhere between $l/2$ and $3l/4$ but preferably $5l/8$. As explained above, these measurements are designed to encourage vibrations propagating along a plane wave parallel to nozzle plate 39. The shape of this cavity will now be explained in more detail with reference to figure 3. As stated above, this figure shows a section through a plane parallel to the nozzle plate located a very short distance from the nozzle plate. The contour of this cavity consists of two planar segments 7, 8 that are generally parallel to one another and located at an approximate distance of $l/4$ from one another. [Said segments] A side of each segment 7, 8 [are] is illustrated in figure 3 as the trace in the [cross-section] cross-sectional plane of [mutually] the parallel [flat walls] segments 7, 8 that [will be referred to hereafter as the large walls] define an inner periphery of a portion of the cavity 6. Said [large walls] segments 7, 8 are connected by [semicircles 9, 10 that are] arcuate planar portions 9, 10, a side of each arcuate planar portion 9, 10 being illustrated in figure 3 as the trace in the [cross-section] cross-sectional plane of the arcuate planar portions 9, 10. It will be seen from this drawing that cavity 6 is not altogether parallelepiped-shaped since [two of its walls 9 and 10 consist of concave walls turning into] a portion of its inner periphery includes arcuate formations causing the cavity 6 [having] in this case to have the shape of half-cylinders with circular bases. As can be seen from figure 2 or figure 4, which is a cross-section through body 133 along line B-B, shown in figure 2, of a cavity, that also passes through the axis of a

jet, [lateral walls] arcuate planar portions 9, 10 and segments 7, 8 of the cavity 6 are joined perpendicularly to nozzle plate 39. This shape makes it possible to avoid upward reflections of waves on the walls induced by the V-shaped form of these walls as described in the WO patent application cited above in the description of the prior art. This shape therefore makes it possible to obtain more regular vibration of the ink in the cavity 6.

The paragraph starting on page 13, line 26, was amended as follows:

The two feed apertures 11 are located symmetrically relative to a central plane of cavity 6 perpendicular to the plane of the jets, and immediately below upper surfaces 107, 108 of the cavity. Ink outlet aperture 12 is located in a housing 13 of [shaker] acoustic wave generator 14. The ink supplied via apertures 11 is intended to keep the cavity 6 filled and under pressure while the ink leaves via the nozzles 36. The ink outlet aperture 12 is used during startup, shutdown and hydraulic maintenance phases of the print head. The relative disposition and cross-sections of ink inlet aperture 11 and ink outlet aperture 12 are optimized to ensure uniform distribution of the ink to the nozzles, so as to ensure that the ink in the cavity is not disturbed by the ink-flow pulsations coming from the ink circuit, to ensure that the ink in the cavity is replaced rapidly (draining), and to eliminate any air bubbles in the cavity by ensuring that there is a high flow-rate of liquid during hydraulic maintenance sequences. The body also contains housings 13 each provided for an acoustic wave generator 14 already known per se that has the basic shape of a cylinder 15 ending in the surface 16 that is parallel to the plane of the nozzles, said surface 16 constituting the vibrating surface of the acoustic wave generator 14. The section of the housing 13 of the acoustic wave generator 14 closest to the cavity has the shape of a cylinder 17.

The paragraph starting on page 14, line 19, was amended as follows:

In figures 2 and 4 the acoustic wave generator 14 is shown in dotted lines, firstly in a position close to its assembled position, and secondly once in its assembled position. In the assembled position the contour of the acoustic wave generator 14 is practically identical in figures 2 and 4 with that of the housing of the generator 14. In the drawings, particularly figures 2 and 4, the housing of the acoustic wave generator 14 is located above cavity 6. This “above” position is in no way compulsory in practice. However, the terms “above” and “below” are used as a convenient spatial reference to describe the position of components relative to one another. In the example shown, the cylinder of the acoustic wave generator 14 is of diameter $l/2$, i.e. half the length of cavity 6 and its axis lies both in the plane of the jets and equidistant between the ends of cavity 6. In operation, the vibrating surface 16 of generator 14 is located level with the upper section of the cavity 6. This arrangement is in no way compulsory and this surface may be disposed slightly higher in the housing 13 of the acoustic wave generator 14. Given the shape of the acoustic chamber and the shape of the housing of generator 14, in order for the acoustic waves to be transmitted efficiently and in a preferred vibration mode through the ink in cavity 6, it is necessary to provide a connection 18 between housing 13 of acoustic wave generator 14 and cavity 6. This connection 18, which consists of a hollow in the [flat walls] segments 7, 8, will now be described.

The paragraph starting on page 15, line 21, was amended as follows:

Figure 5A shows the shape of the cross-section of cavity 6 as a plane parallel to the plate 39 carrying the nozzles 36. The projection on the cross-section plane of cylinder 17 forming the housing of acoustic wave generator 14 is also shown in dotted lines on a section outside cavity 6 and in unbroken lines inside cavity 6. The centre of the circle representing this projection is located on the longitudinal axial line of cavity 6 equidistant between the two ends of this cavity. For the sections of the connection located between the two [planes defined by each of plane surfaces 7 and 8] planar segments 7, 8 of cavity 6 [comprising segments 7 and 8] shown in figure 5A, the connection surface [consists] includes as shown in part A of continuations 19 and 20, shown by unbroken lines, of the cylindrical section 17 of the housing 13 of acoustic wave generator 14. In this way, looking at connection 18 along an axial line of a jet, it will be seen to have a shape whose projection onto the cross-section plane shown in figure 5A will now be explained.

The paragraph starting on page 16, line 7, was amended as follows:

This opening is composed of a closed cylindrical surface comprising, on the one hand, [parts] continuations 19 and 20 fo the cylindrical surface and, on the other, the flat parts of the surfaces of the planes containing segments 7 and 8 lying between the ends of said [parts] continuations 19 and 20 of the cylinders. The shape of that section of the lateral surface of connection 18 that lies between [parts] continuations 19 and 20 of the cylindrical surface will now be explained.

The paragraph starting on page 16, line 16, was amended as follows:

In order to define this shape, figure 5B shows a cross-section through the wall of [housing] connection 18 in a plane parallel to the nozzle plate located between a low end section and a high end section of connection 18. The cross-section of this connection consists of a line comprising, in order, an end of [cylindrical wall] continuation 19, a straight section 22 that is part of segment 7, followed by a curved section 21, and finally another section 23 of segment 7, an end of [cylindrical wall] continuation 20 and sections 23', 21', 22' that are respectively symmetrical with sections 23, 21, 22 relative to a longitudinal axis XX' of the cavity. We will now consider the variations in the length of said curved section 21 between the low end section of the wall and the high end section. In the low end section of connection 18 the length of curved section 21, shown in part A of figure 5, is nil such that the perimeter of the section is composed of sections of [circles] continuations 19 and 20, [parts] sections 22, 23 of segment 7 joining the ends of [circles] continuations 19 and 20 and [parts] sections 22', 23' of segment 8 joining the ends of said [parts] continuations 19, 20. When the cross-section plane located between the low end sections and the high end sections approaches the high end section the measurements of [segments] sections 22, 23 located between curved section 21 and each of [circles] continuations 19, 20 respectively diminish and the length of [curve] section 21 increases. As the high end section as shown in part C of figure 5 is reached the length of [segments] sections 22 and 23 is nil and [curve] section 21 consists of a circular section [locating in the continuation of circles] forming a continuous arcuate portion extending between continuations 19 and 20.

The paragraph starting on page 17, line 12, was amended as follows:

Naturally if housing 13 and generator 14 were not circular cylinders but had a different shape, [curve] section 21 at the top would have the shape resulting from an intersection of this shape with a plane parallel to the nozzle plate. In the example described the intersection of high end section of connection 18 with a plane parallel to nozzle plate 39 consists of a circular closed line whose diameter is equal to the diameter of housing 13 of acoustic wave generator 14, for example 1/2. The perimeter of this line is the perimeter of the circle. For an intermediary plane between the high end section and the low end section the perimeter of the straight cross-section of connection 18 by a plane parallel to nozzle plate 39 is formed [one] on the one hand by [sections] continuations 19, 20 of the circle, by [parts] sections 22, 23 of segment 7, by a curved section 21'. The perimeter of this intermediate cross-section is therefore smaller than the diameter of the circle located at the high end section. Similarly, coming to the low end part, the cross-section of connection 18 by a plane parallel to nozzle plate 39 has the shape shown in part A, i.e. two [sections] continuations 19, 20 of a circle and two sections of segments 7 and 8 located between said two sections of [circles] continuations 19, 20. The perimeter of the low end part shown in part A, is therefore smaller than the perimeter of the intermediate lower part shown in part B. Therefore the shape of connection 18 can be characterized by saying that the perimeter of its cross-section by a plane parallel to nozzle plate 39 reduces the further the plane of intersection is from the upper limit and approaches the lower limit.

The paragraph starting on page 18, line 10, was amended as follows:

It will also be noted that the ends of each of [curves] sections 21, 21' are located facing one another and thus separated from one another by a distance between segments 7 and 8 of the first contour. In order for good plane propagation of the acoustic waves to occur, the walls of cavity 6 and connection 18 need to have rotational symmetry, i.e. symmetry relative to an axis or to two perpendicular planes passing through the said axis.

The paragraph starting on page 18, line 19, was amended as follows:

In one simple embodiment, part of connection 18 is made using a conical drill bit with an angle at its tip of, for example, 90°. When the bit is conical the different [curves] sections 21 are segments of circles of nil diameter at the lower end section and a diameter equal to that of housing 13 of the acoustic wave generator 14. This embodiment is shown in figures 2 and 4. In figure 2 the intersection of the cone with the plane of [surface] segment 7 of the cavity results in a segment 24 of a hyperbola while figure 4, in which the cross-section is along section B-B, i.e. more or less along the axis of housing 13 of acoustic wave generator 14, the intersection has the shape of two 90° segments 26. In this example, moreover, the low end section of housing 13 coincides with the high end section of cavity 6 and thus a low end section 25 of connection 18 is positioned at a distance from the top of cavity 6 slightly less than half the diameter of the cylindrical section of housing 13 of [acoustic] acoustic wave generator 14.[\$\$]

The paragraph starting on page 19, line 5, was amended as follows:

Another important characteristic of the invention will now be explained. As was seen above, because the [lateral walls] segments 7, 8 and arcuate planar portions 9, 10 of the cavity are perpendicular to the nozzle plate 39 at the level of said nozzle plate 39 and that the section of connection 18 between the lower surface 16 of [resonator] acoustic wave generator 14 and cavity 6 is created progressively, a plane wave perpendicular to the axis of housing 13 propagates in cavity 6. As this wave is plane, no problems are created due to boundary [effect] effects. Consequently a nozzle 361, 362 may be positioned very close to one of [walls] arcuate planar portions 9, 10 without its operation being affected. For example, it will be seen from figures 2 and 3 that an end-nozzle 361 is located very close to the [outer wall] arcuate planar portion 10 of cavity 6. Similarly it will be seen that an end-nozzle 362 is located very close to [a wall] the arcuate planar portion 9 separating two identical cavities of body 133. The closeness of nozzle 361 to the [outer wall] arcuate planar portion 10 allows the axis of the nozzle to be at a distance less than half the interval between two consecutive nozzles of the cavity even if said interval is small. Similarly the distance between end-nozzle 362 of [wall] arcuate planar portion 9 between two cavities 6 allows the distance between this nozzle 362 and the next consecutive nozzle located in the other cavity of body 133 to be less than the distance between two consecutive nozzles in a single cavity. Hence the interval between consecutive nozzles of all the nozzles in the two cavities remains equal, even when it is small. Moreover, due to the fact that the distance between one end-nozzle and the outer surface of the [wall] portion where it intersects with the axis of the nozzles is less than half the interval between two nozzles, it becomes possible to place side by side two modules that are, for example, identical or have the same characteristic that the closeness of the nozzle of

one cavity relative to the outer surface of the body containing [the] said cavity, without the interval between two consecutive nozzles of the resulting assembly being modified.

The paragraph starting on page 21, line 28, was amended as follows:

During maintenance operations the ink outlet occurs higher through an aperture 12 (shown in figure 2) located in the cylindrical section 15 of housing 13 of acoustic wave generator 14. The ink flows towards outlet aperture 12 from cavity 6 through a clearance between the cylindrical section 15 and [resonator] acoustic wave generator 14. The use of a single outlet aperture 12 eliminates areas of static fluid and optimizes drainage of the ink cavity. Finally, in normal operation the solenoid valves controlling the print head prevent ink from flowing through outlet aperture 12; the ink around this aperture is therefore static. It also acts as a lubricant and vibration insulator for [resonator] the acoustic wave generator 14.

MARKED-UP COPY OF THE CLAIMS

IN THE CLAIMS

Claims 1, 4, 5, 6, 11, 12, and 14 were amended as follows:

1. (Amended) An ink-drop generator for an inkjet printer in which an inkjet is sprayed in drops, said generator particularly comprising:

- a generator body,
- at least one acoustic wave generator with a body elongated in an axial direction to the [inkjets] inkjet, each generator having a vibrating surface perpendicular the axial direction of the jets, at least one section comprising the vibrating surface of each acoustic generator being housed in a housing of the drop-generator body,
- at least one resonance cavity intended to contain ink, [the] a first section only of each cavity possibly being constituted in a main section of said generator body [constituting the main body of the generator] and, in this configuration, a second section in a continuation of said [main] generator body [of the generator] connected to be leaktight to the [main] generator body [of the generator], each cavity having an ink feed, each cavity being defined particularly by a nozzle plate and a [lateral] wall [secant to the nozzle plate], the intersection of the [lateral] wall and the nozzle plate defining a first plane contour line of the [lateral] wall, the nozzle plate comprising a plurality of nozzles aligned along an axial direction of the nozzles perpendicular to the axial direction of the jets, the axial direction of the jets and the axial [line] direction of the nozzles defining a plane of the jets,
- a generator characterized in that the [lateral] wall of each resonance cavity is [secant to the nozzle plate] perpendicular to said nozzle plate [along the entire first contour line of said wall], the first contour line being formed by two equal segments that are parallel to one

another and the axial direction of the nozzles, each segment having two ends: a first and a second end, the two first ends of each segment being connected by a first curved line and the two second ends of each segment being connected by a second curved line.

4. (Amended) Generator of claim 1 characterized in that the largest measurement of the first contour of the cavity lies along the axial [line] direction of the nozzles, the distance between the two segments being approximately $[\cdot/4]$ $1/4$ and the height of the [lateral] wall being between $[\cdot/2]$ $1/2$ and $[3\cdot/4]$ $3/4$.

5. (Amended) Drop generator of claim 4 characterized in that the acoustic-wave generator has a circular, transverse cross-section the diameter of which is between $[\cdot/2]$ $1/2$ and $[3\cdot/4]$ $3/4$.

6. (Amended) Generator of claim 5 characterized in that one part of the acoustic-wave generator housing has [at] an opening having a cross-section the length of which is more or less equal to $[\cdot/2]$ $1/2$.

11. (Amended) Generator of claim 1 characterized in that one of the ink-feed apertures is located at one end and the other at a second end of a segment of the cavity, and an ink outlet opening in the body housing is located at [the] a top of the cavity [, an ink outlet opening in the body housing].

12. (Amended) Generator of claim 1 characterized in that the nozzles of [a] the cavity are equidistant and that the distance between an end nozzle and of an end cavity of the

body and a section of the external wall of the body located at the intersection of said wall with the jet plane is shorter than half the distance between two consecutive nozzles of the nozzle plate.

14. (Amended) [Drop generator] Generator of claim 13 characterized in that it is equipped with positioning means aligned parallel to the axial [line] direction of the nozzles.